

CLAIMS:

1. A method of metal doping a chalcogenide material comprising:
forming a metal over a substrate;
forming a chalcogenide material on the metal; and
irradiating through the chalcogenide material to the metal effective to
break a chalcogenide bond of the chalcogenide material at an interface of the
metal and chalcogenide material and diffuse at least some of the metal
outwardly into the chalcogenide material.

2. The method of claim 1 wherein the metal comprises elemental
silver.

3. The method of claim 1 wherein the chalcogenide material having
metal ions diffused therein comprises Ge_xA_y , where A is selected from the
group consisting of Se, Te and S, and mixtures thereof.

4. The method of claim 1 wherein the irradiating diffuses only
some of the metal outwardly into the chalcogenide material.

5. The method of claim 1 wherein the irradiating diffuses all of the
metal outwardly into the chalcogenide material.

1 6. A method of metal doping a chalcogenide material comprising:
2 surrounding exposed outer surfaces of a projecting metal mass with
3 chalcogenide material; and

4 irradiating through the chalcogenide material to the projecting metal
5 mass effective to break a chalcogenide bond of the chalcogenide material at
6 an interface of the projecting metal mass outer surfaces and diffuse at least
7 some of the projecting metal mass outwardly into the chalcogenide material.

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9 7. The method of claim 6 wherein the projecting mass and outer
10 surfaces comprises a top surface joined with opposing side surfaces at
11 respective angles.

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13 8. The method of claim 6 wherein the projecting mass and outer
14 surfaces comprises a top surface joined with opposing side surfaces at
15 respective angles within about 15° degrees of normal.

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17 9. The method of claim 6 wherein the irradiating diffuses only
18 some of the projecting metal mass outwardly into the chalcogenide material.

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20 10. The method of claim 6 wherein the irradiating diffuses all of the
21 projecting metal mass outwardly into the chalcogenide material.

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23 11. The method of claim 6 wherein the projecting metal mass has
24 a shape which is maintained after the irradiating but at a reduced size.

1 12. The method of claim 6 wherein the surrounding comprises blanket
2 depositing of the chalcogenide material.

3
4 13. A method of metal doping a chalcogenide material comprising:
5 forming a metal over a substrate;
6 patterning the metal into a structure having an outer surface;
7 forming a chalcogenide material on the metal structure outer surface;
8 and

9 irradiating through the chalcogenide material to the patterned metal
10 effective to break a chalcogenide bond of the chalcogenide material at an
11 interface of the patterned metal outer surface and the chalcogenide material
12 and diffuse at least some of the metal outwardly into the chalcogenide
13 material.

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15 14. The method of claim 13 wherein the patterning is subtractive of
16 the metal.

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18 15. The method of claim 13 wherein the patterning comprises
19 photolithography.

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21 16. The method of claim 13 wherein the irradiating diffuses only
22 some of the metal outwardly into the chalcogenide material.
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1 17. The method of claim 13 wherein the irradiating diffuses all of
2 the metal outwardly into the chalcogenide material.

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4 18. The method of claim 13 wherein the structure has a shape which
5 is maintained after the irradiating but at a reduced size.

6
7 19. A method of metal doping a chalcogenide material comprising:
8 forming a metal over a substrate;
9 patterning the metal into a structure having an outer surface;
10 blanket depositing a chalcogenide material over the substrate and on the
11 metal structure outer surface;

12 irradiating through the chalcogenide material to the patterned metal
13 effective to break a chalcogenide bond of the chalcogenide material at an
14 interface of the patterned metal outer surface and the chalcogenide material
15 and diffuse at least some of the metal outwardly into the chalcogenide
16 material, and thereby metal doping only a portion of the blanket deposited
17 chalcogenide material; and

18 substantially selectively etching chalcogenide material not doped with the
19 metal from the metal doped portion of the chalcogenide material.

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21 20. The method of claim 19 wherein the depositing comprises
22 chemical vapor deposition.
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1 21. The method of claim 19 wherein the forming comprises a blanket
2 deposition.

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4 22. The method of claim 19 wherein the etching comprises dry
5 anisotropic etching.

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7 23. The method of claim 19 wherein the etching comprises dry
8 anisotropic etching using a gas chemistry comprising CF_4 .

9
10 24. The method of claim 19 wherein the irradiating diffuses only
11 some of the metal outwardly into the chalcogenide material.

12
13 25. The method of claim 19 wherein the irradiating diffuses all of
14 the metal outwardly into the chalcogenide material.

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16 26. The method of claim 19 wherein the structure has a shape which
17 is maintained after the irradiating but at a reduced size.

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19 27. The method of claim 19 wherein the etching removes all
20 chalcogenide material not doped with the metal from the substrate.

1 28. A method of forming a non-volatile resistance variable device,
2 comprising:

3 surrounding exposed outer surfaces of a projecting metal mass with
4 chalcogenide material;

5 irradiating through the chalcogenide material to the projecting metal
6 mass effective to break a chalcogenide bond of the chalcogenide material at
7 an interface of the projecting metal mass outer surfaces and diffuse at least
8 some of the projecting metal mass outwardly into the chalcogenide material;
9 and

10 after the irradiating forming an outer electrode over the chalcogenide
11 material.

12
13 29. The method of claim 28 wherein the projecting metal mass and
14 outer surfaces comprises a top surface joined with opposing side surfaces at
15 respective angles.

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17 30. The method of claim 28 wherein the projecting metal mass and
18 outer surfaces comprises a top surface joined with opposing side surfaces at
19 respective angles within about 15° degrees of normal.

20
21 31. The method of claim 28 wherein the projecting metal mass has
22 a shape which is maintained after the irradiating but at a reduced size.
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1 32. The method of claim 28 wherein the surrounding comprises
2 blanket depositing of the chalcogenide material.

3
4 33. A method of forming a non-volatile resistance variable device,
5 comprising:

6 forming a first metal layer over a substrate;

7 forming a second metal layer on the first metal layer;

8 patterning the second metal layer into a structure having an outer
9 surface, and exposing the first metal layer;

10 blanket depositing a chalcogenide material over the substrate on the
11 second metal structure outer surface and on the exposed first metal layer;

12 irradiating through the chalcogenide material to the patterned second
13 metal effective to break a chalcogenide bond of the chalcogenide material at
14 an interface of the patterned second metal outer surface and the chalcogenide
15 material and diffuse at least some of the second metal outwardly into the
16 chalcogenide material, and thereby second metal doping only a portion of the
17 blanket deposited chalcogenide material;

18 substantially selectively etching chalcogenide material not doped with the
19 second metal from the second metal doped portion of the chalcogenide
20 material; and

21 after the etching, forming an outer electrode over the chalcogenide
22 material.

1 34. The method of claim 33 wherein the etching comprises dry
2 anisotropic etching.

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4 35. The method of claim 33 wherein the etching comprises dry
5 anisotropic etching using a gas chemistry comprising CF_4 .

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7 36. The method of claim 33 wherein the irradiating diffuses only
8 some of the metal outwardly into the chalcogenide material.

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10 37. The method of claim 33 wherein the structure has a shape which
11 is maintained after the irradiating but at a reduced size.

12
13 38. A non-volatile resistance variable device, comprising:
14 a substrate comprising a first metal layer;
15 an insulative layer received over the first metal layer;
16 a resistance variable chalcogenide material having metal ions diffused
17 therein received within an opening formed through the insulative layer;
18 a projecting metal mass extending outwardly from the first metal layer
19 laterally central into the resistance variable chalcogenide material; and
20 an electrode spaced from the projecting metal mass and first metal
21 layer operatively adjacent the resistance variable chalcogenide material.

22
23 39. The device of claim 38 in a highest resistance state for a given
24 ambient temperature and pressure.

1 40. The device of claim 38 wherein the projecting metal mass
2 comprises a top surface joined with opposing side surfaces at respective
3 angles.

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5 41. The device of claim 38 wherein the projecting metal mass
6 comprises a top surface joined with opposing side surfaces at respective angles
7 within about 15° degrees of normal.

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9 42. The device of claim 38 wherein the metal mass comprises
10 elemental silver.

11
12 43. The device of claim 38 wherein the chalcogenide material having
13 metal ions diffused therein comprises Ge_xA_y , where A is selected from the
14 group consisting of Se, Te and S, and mixtures thereof.

15
16 44. A non-volatile resistance variable device in a highest resistance
17 state for a given ambient temperature and pressure, comprising:

18 a resistance variable chalcogenide material having metal ions diffused
19 therein; and

20 opposing first and second electrodes received operatively proximate the
21 resistance variable chalcogenide material, at least one of the electrodes
22 comprising a conductive projection extending into the resistance variable
23 chalcogenide material.

1 45. The device of claim 44 wherein the conductive projection
2 comprises a top surface joined with opposing side surfaces at respective
3 angles.

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5 46. The device of claim 44 wherein the conductive projection
6 comprises a top surface joined with opposing side surfaces at respective angles
7 within about 15° degrees of normal.

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9 47. The device of claim 44 wherein the one electrode and the
10 conductive projection comprise the same material.

11
12 48. The device of claim 44 wherein the one electrode and the
13 conductive projection comprise elemental silver.

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15 49. The device of claim 44 wherein the conductive projection
16 comprises elemental silver.

17
18 50. The device of claim 44 wherein the chalcogenide material having
19 metal ions diffused therein comprises Ge_xA_y , where A is selected from the
20 group consisting of Se, Te and S, and mixtures thereof.